Designing Drains & Sewers

Richard Eddy

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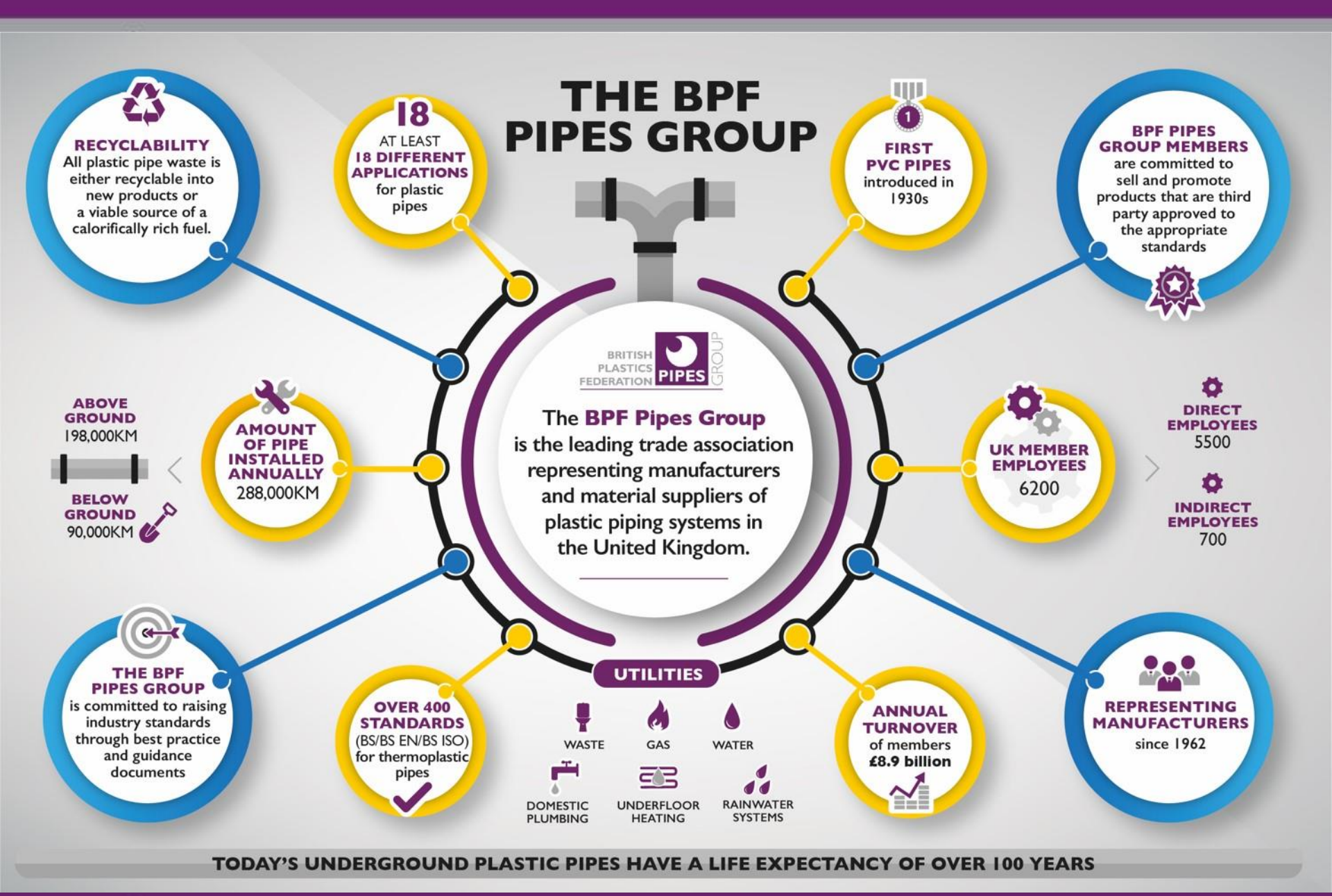
BRITISH PLASTICS FEDERATION PIPES GROUP

THE BPF PIPES GROUP



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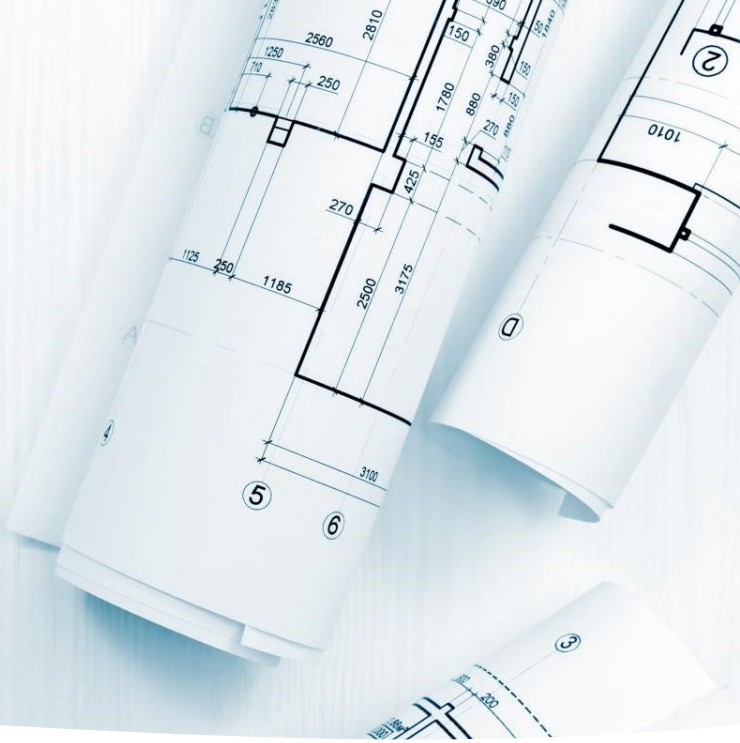
Learning objectives

- The effective design of drains and sewers is important for their correct functioning
- Modern materials and methods can assist in functional design
- Current regulations are generally material agnostic and allow plastics in many situations

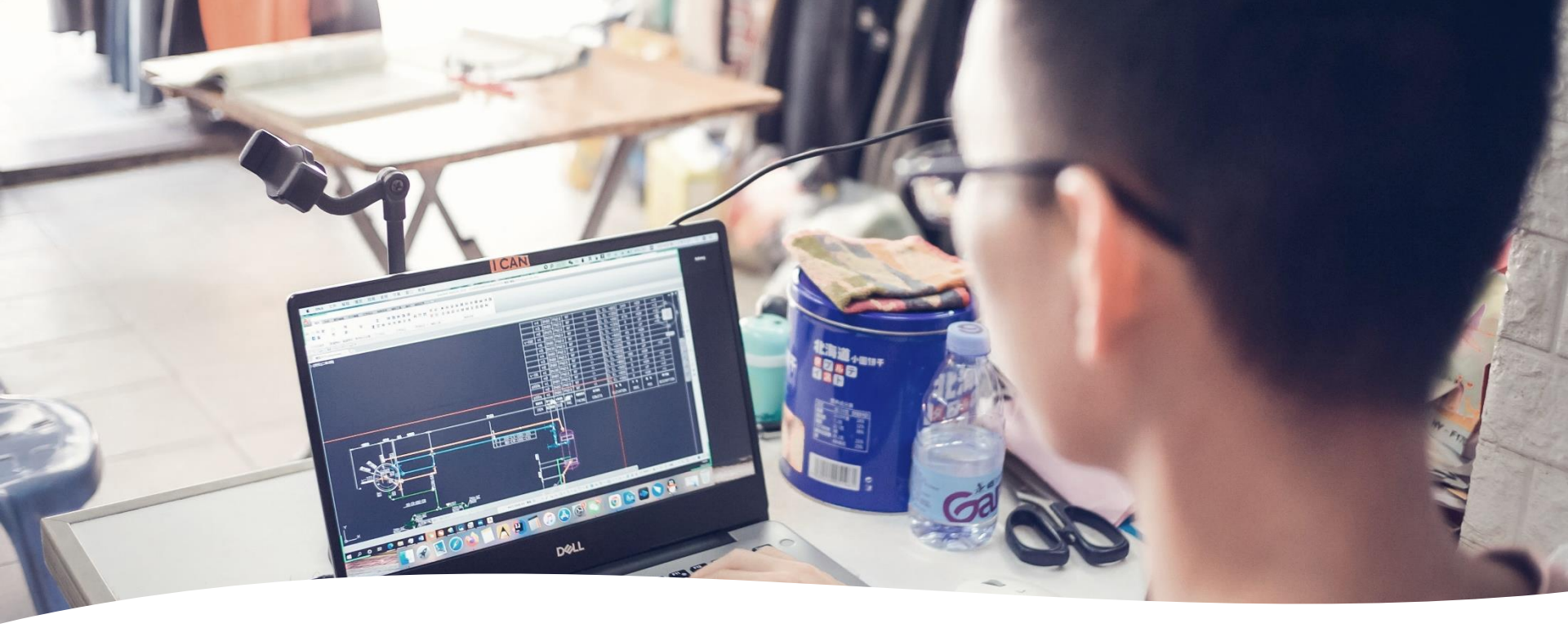
Introduction

- Drain and Sewer systems are part of the collection and transport element of the overall wastewater system that moves foul and surface water from the point of capture to the point of treatment or discharge.
- The effective design of the Drains and Sewers is critical to ensure the whole system performs as intended
- In the UK, there is a split of responsibility between ‘private’ and ‘public’ parts of the system with different requirements.



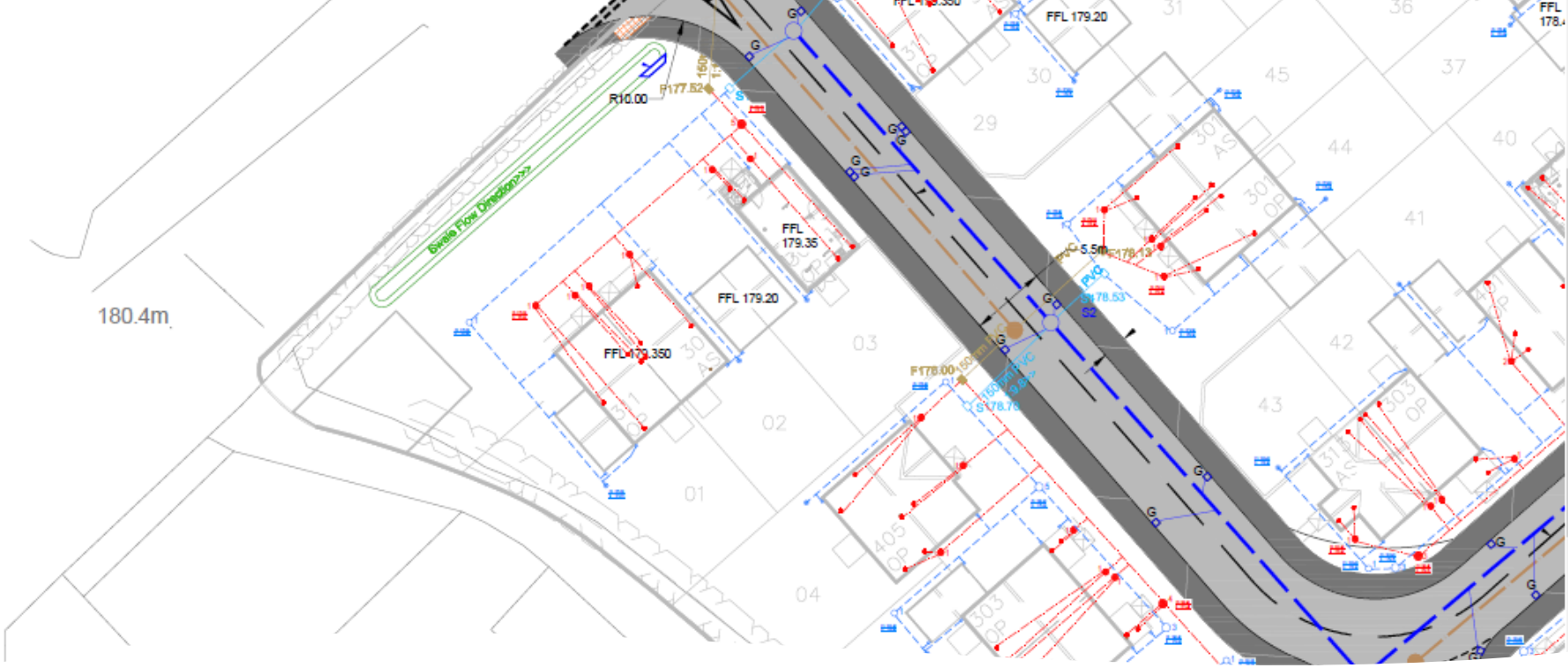
Design overview

- Design is the process of defining the project in sufficient detail so that instructions can be given to others for the system to be constructed or maintained
- The design should be safe and meet functional requirements in a cost-effective manner
- Effective designs will take into account the whole life costs of the system, utilising modern materials where appropriate and making allowances for future changes



Main design elements

- Layout
- Hydraulic
- Structural
- Regulatory



Design Element: Layout

- The layout of the system is influenced by the topography of the site and the current infrastructure or natural elements already in place
- Preliminary work will enable the site to be evaluated prior to the design of the physical layout
- Economical layouts usually follow the natural fall of the land, utilising gradients which are self cleansing
- Access should be provided for cleaning and maintenance

Design Element: Hydraulic

- The design of the system should meet all of the functional requirements, including protection from flooding; maintenance and flow
- Foul and surface water drainage systems have different hydraulic requirements

Design Element: Structural

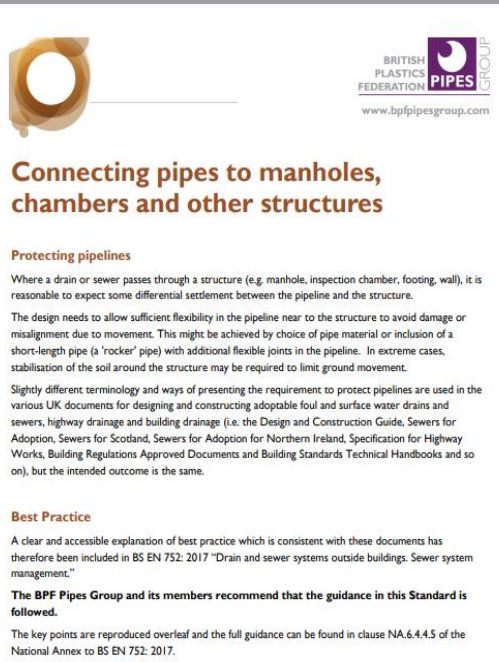
- The design of the system should meet all of the functional requirements, including structural integrity, design life, use of sustainable products and not endangering adjacent structures or utilities
- The structural design will take account of elements such as loads, maintaining watertightness, ground conditions (including contamination) and regulatory requirements

Design Element: Regulatory

- Regulatory requirements differ across the nations of the UK.
- The requirements also differ between private drainage and adoptable drainage
- Regulations are material agnostic and allow for the use of plastics

Resources and sources of information: Industry guidance

- British Standards
  - BS EN 16933-2
  - BS EN 1295-1
  - BS 9295
  - BS EN 1610
- Approved Documents and Sewer Adoption Codes



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Connecting pipes to manholes, chambers and other structures

Protecting pipelines

Where a drain or sewer passes through a structure (e.g. manhole, inspection chamber, footing, wall), it is reasonable to expect some differential settlement between the pipeline and the structure.

The design needs to allow sufficient flexibility in the pipeline near to the structure to avoid damage or misalignment due to movement. This might be achieved by choice of pipe material or inclusion of a short-length pipe (a 'rocker' pipe) with additional flexible joints in the pipeline. In extreme cases, stabilisation of the soil around the structure may be required to limit ground movement.

Slightly different terminology and ways of presenting the requirement to protect pipelines are used in the various UK documents for designing and constructing adoptable foul and surface water drains and sewers, highway drainage and building drainage (i.e. the Design and Construction Guide, Sewers for Adoption, Sewers for Scotland, Sewers for Adoption for Northern Ireland, Specification for Highway Works, Building Regulations Approved Documents and Building Standards Technical Handbooks and so on), but the intended outcome is the same.

Best Practice

A clear and accessible explanation of best practice which is consistent with these documents has therefore been included in BS EN 752: 2017 "Drain and sewer systems outside buildings. Sewer system management."

The BPF Pipes Group and its members recommend that the guidance in this Standard is followed.

The key points are reproduced overleaf and the full guidance can be found in clause NA.6.4.4.5 of the National Annex to BS EN 752: 2017.

Resources and sources of information: BPF guidance

- BPF Pipes Group Technical Guidance and Specification Guidance – https://www.bpfpipesgroup.com/support-downloads/overview/

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Some questions asked by designers

and where to look for answers

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- What is the minimum gradients allowed for foul or surface water drains
  - Building Regulations set out the minimum gradients for drains, these are based on the flow in the drains and the number of appliances connected, replicated in other guidance

Table 6 **Recommended minimum gradients for foul drains**

Peak flow (litres/sec)	Pipe size (mm)	Minimum gradient (1 in ...)	Maximum capacity (litres/sec)
< 1	75	1:40	4.1
	100	1:40	9.2
> 1	75	1:80	2.8
	100	1:80*	6.3
	150	1:150†	15.0

Notes:

* Minimum of 1 WC

† Minimum of 5 WCs

Pipe gradients and sizes

3.13 Drains should have enough capacity to carry the flow. The capacity depends on the size and gradients of the pipes.

3.14 Drains should be at least 75mm diameter. Surface water sewers (serving more than one building) should have a minimum size of 100mm. Diagram 3 shows the capacities of drains of various sizes at different gradients. However the capacity can be increased by increasing the gradient, or by using larger pipes.

3.15 75mm and 100mm rainwater drains should be laid at not less than 1:100. 150mm drains and sewers should be laid at gradients not less than 1:150 and 225mm drains should be laid at gradients not less than 1:225. For minimum gradients for larger pipes see BS EN 752-4 (see paragraph 3.36).

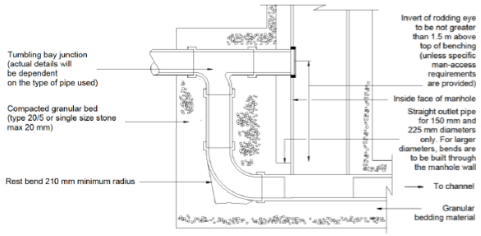
- What is the maximum gradient used on foul or surface water drain
  - There is no maximum gradient for drains and sewers, the reasoning for this is set out National Annex to BS EN 752:2017
  - Sewer Guidance also specifies that steeper gradients are preferred to backdrop manholes

NA.6.3 Sewers with steep gradients

Research has demonstrated that high velocities of flow in drains and sewers laid at steep gradients do not cause increased erosion of pipes [35] or deposition of solids [36] for commonly used sewer materials. Experience has shown that drains may therefore be laid at gradients to optimize excavation and cost.

Figure B 17
Typical vertical and ramped backdrop detail (flexible materials)
For use in manhole types A to D

Note: Steeper gradients are preferred to the use of backdrops.
Type of backdrop to be used to be agreed with the sewerage company.



External Vertical Backdrop

- What is the maximum distance between inspection chambers or other access points
  - Building Regulations set out the maximum distance between Access points including manholes, inspection chambers and rodding points
  - Similar guidance is offered in Sewer Guidance and BS EN 752:2017

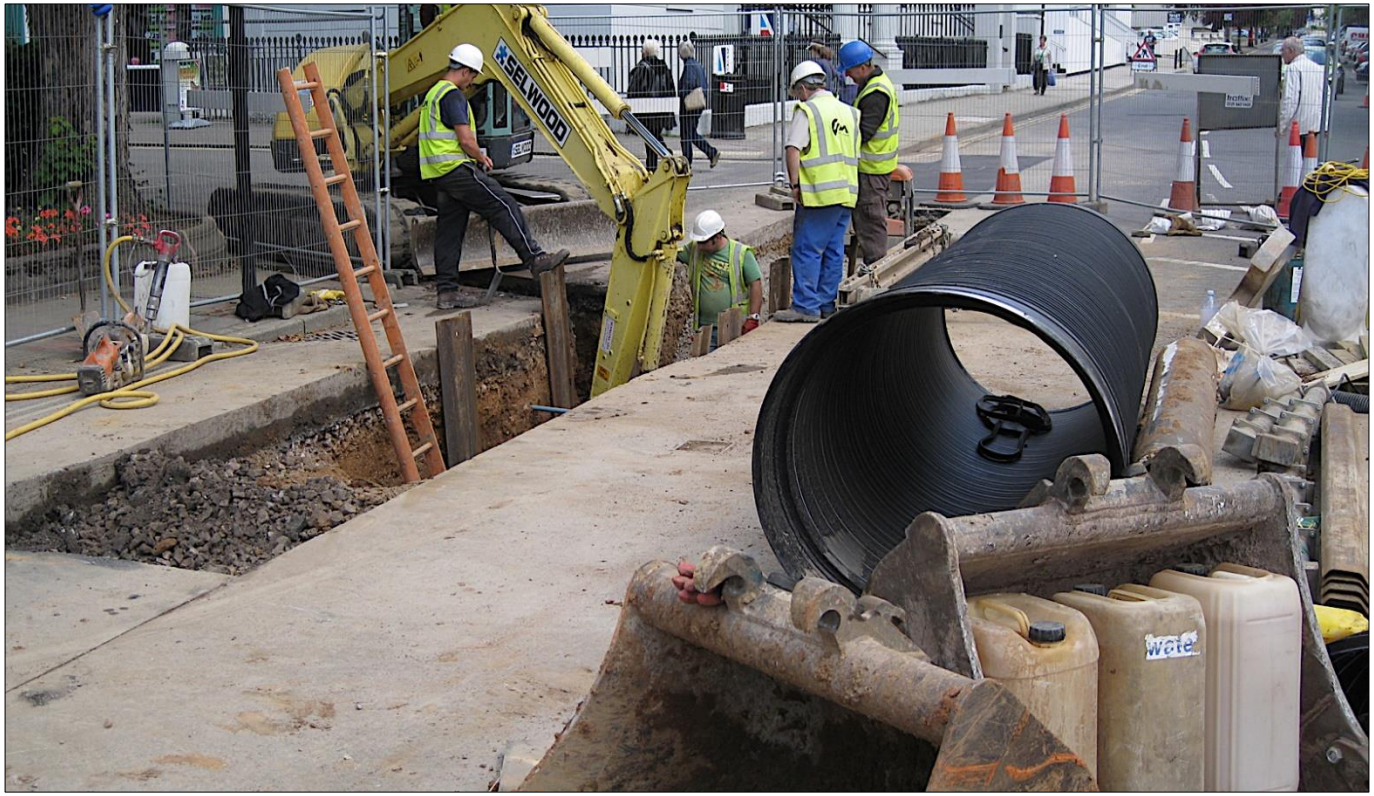
Table 13 **Maximum spacing of access points in metres**

From	To Access Fitting		To Junction	To Inspection chamber	To Manhole
	Small	Large			
Start of external drain [1]	12	12	–	22	45
Rodding eye	22	22	22	45	45
Access fitting: small 150 diam. and 150 x 100 large 225 x 100	 – –	 – –	 12 22	 22 45	 22 45
Inspection chamber shallow	22	45	22	45	45
Manhole and inspection chamber deep	–	–	–	45	90 [2]

Notes:

1. Stack or ground floor appliance
2. May be up to 200 for man-entry size drains and sewers

Any questions?



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Contact Details

Web: www.bpfpipesgroup.com
Email: carol.day@bpfpipesgroup.com
Tel: 07807 113537